CONTRIBUTIONS TO THE MOSQUITO FAUNA OF SOUTHEAST ASIA. X.

CONTENTS

THE GENUS *CULISETA* FELT IN SOUTHEAST ASIA[1]

By

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INTRODUCTION

The genus *Culiseta* was erected by Felt (1904) for a mosquito he had previously described under the name *Culex absobrinus* at the same time he erected *Culicella* for *Culex dyari* Coquillett. Until recently mosquitoes of Felt's genera have been known under the generic name of *Theobaldia*. This had been proposed by Neveu-Lemaire (1902) for *Culex annulatus* Schrank, a species subsequently placed by Blanchard (1905) in another new genus *Theobaldinella*. A related genus *Pseudotheobaldia* was described by Theobald (1907) for *niveitaeniata*. However, Stone et al. (1959) pointed out that Fischer (1885) had already used the generic name *Theobaldia* and that the next available name was *Culiseta* Felt (1904). The name *Culicella* has been retained as a subgenus but the others have become synonyms. Edwards (1921) in a revision of the mosquitoes of the Palaearctic region divided the genus into three subgenera *Theobaldia*, *Culicella* and *Allotheobaldia*. These were defined mainly on larval structure. Edwards expressed the opinion that *Leptosomatomyia fraseri* Edwards should probably be included in this genus and in 1930 he introduced for it the subgeneric name *Theomyia*. Later *Culex melanurus* Coquillett was also transferred to the genus with the subgeneric name *Climacura* Howard, Dyar & Knab (1915). These five subgenera were listed in the Genera Insectorum (Edwards 1932), and with two new ones, *Austrotheobaldia* (1954) and *Neotheobaldia* (1958) introduced by Dobrotworsky for Australian species make up a total of seven recognized by Stone et al. (1959). Edward's assessment of the importance of larval characters for the recognition of subgenera has been widely accepted. Maslov (1964), however, believes that more attention should be paid to adult structure. With this approach, he has limited the genus *Culiseta* to include only the four subgenera *Culiseta*, *Culicella*, *Climacura* and *Neotheobaldia*; the remaining three, *Allotheobaldia*, *Austrotheobaldia* and *Theomyia* he regards as full genera.

In my opinion Maslov's treatment of the genus is not justified. No doubt there are different degrees of relationships between the various subgenera and some are clearly more specialized than others but there are advantages in employing larger generic concepts. As Edwards (1932) has pointed out, this means that "the wider relationships of the species are more clearly indicated" and that "limits can more readily be assigned to the genera than in the case of more numerous and smaller groups."

In this review I shall follow Belkin (1962) and treat the tribe Culisetini (Stone 1957) as monotypic with the single genus *Culiseta*. The genus contains mosquitoes with generalised characters which place them amongst the nearest living representatives of the primitive stock, or stocks, of the Culicinae (Edwards 1932; Belkin 1962; Marks 1968). It includes seven subgenera, which are based mainly on larval characters, 35 species and seven subspecies.

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GENUS *CULISETA* FELT

Theobaldia Neveu-Lemaire 1902, C.R. Soc. Biol., Paris 54: 1331 (non Fischer 1885). Orthotype: *Culex annulatus* Schrank.
Culiseta Felt 1904, Bull. N.Y. St. Mus., no. 79: 391c. Orthotype: *Culex absobrinus* Felt.
Theobaldinella Blanchard 1905, Les Moustiques :390. Diatype: *Culex annulatus* Schrank.
Pseudotheobaldia Theobald 1907, Mon. Cul. 4: 271. Haplotype: *niveitaeniata* Theobald.

FEMALE. Medium sized to large. *Head.* Eyes almost touching; vertex clothed mainly with narrow, curved decumbent and upright forked scales; lateral scales broad, flat; antenna shorter than proboscis; palpus always short, 5-segmented; segment 5 short or minute; proboscis moderately long, not swollen at apex. *Thorax.* Anterior pronotum small, widely separated, usually with bristles and scales; posterior pronotum with several bristles and sometimes with scales; scutum clothed with narrow scales; acrostichal and dorsocentral bristles numerous but not very long; scutellum usually with narrow scales, rarely with broad; pleural scales varied in shape and distribution; spiracular bristles present, usually numerous and pale in colour; in some species these reduced in number to a few or a single one. *Legs.* Bristles well developed on femora and tibiae; tarsi all dark, banded, or pale apically; claws of all legs small, subequal, simple; pulvillae absent. *Wing.* Frequently with dark pattern of scales; wing membrane with distinct microtrichia; cell R_2 longer than vein R_{2+3}; vein 1A somewhat sinuous; base of Sc ventrally with patch of hairs and sometimes with a few scales as well (except *fraseri* which have no hairs ventrally on base of Sc); alula and squama with marginal row of hairlike scales or bristles. *Abdomen.* Terga, except tergum I, and sterna almost completely scaled; tergum I always with numerous long bristles; abdomen blunt tipped, segment VII not retractile; cercus and post-genital plate short and broad; three large, equal spermathecae.

MALE. In general, similar to female. *Head.* Antenna strongly plumose; palpus variable in length, usually as long as proboscis (about a half length of proboscis in *fraseri* and two-thirds of it in *longiareolata);* last two segments of palpus sometimes turned upwards or more or less swollen. *Terminalia.* Apical margin of tergum VII with (in *longiareolata*) or without stout spines; lobes of tergum IX with several setae; basimere usually rather long, more or less conical; basal mesal lobe present; subapical lobe usually absent; distimere simple, usually with single, simple or bifid terminal appendage, *longiareolata* alone has two terminal appendages; phallosome simple; aedeagus conical, rarely with small teeth at top and only in *marchettei* with prominent teeth; paraproct strongly sclerotized with one or more teeth; clasperte absent.

PUPA. *Cephalothorax.* Hairs 8-C and 9-C caudad of trumpet; respiratory trumpet short with large opening. *Abdomen.* Hair 1-I a well developed, dendritic. *Paddle.* Usually more or less finely serrate and with one or two hairs at tip of midrib, in *fraseri* these hairs are absent.

LARVA. *Head.* Usually wider than long; antenna varied in length; shaft spiculate; hair 1-A varied in position, always well developed and branched; mouth brushes numerous, all filamentous or inner serrated distally; mentum broad, triangular with numerous teeth; hairs 5-7-C well developed, 5-C frequently single. *Thorax.* Hairs 1-3-P and 9-12-P, M, T on large common tubercles; all other large hairs on more or less distinct separate basal tubercles or plates. *Abdomen.* Hairs 6-I-VI of similar length; hair 7-I long, markedly different from 7-II-VI; 2-VIII and 4-VIII usually single or 2-branched; 1, 3, 5-VIII usually multibranched; comb scales in triangular patch or a single row, no sclerotized plate; siphon varied in length; acus present; pecten usually

of strong teeth (only in subgenus *Neotheobaldia* pecten teeth in form of hairs); hair 1-S at base of siphon (only in subgenus *Austrotheobaldia* 1-S half-way along siphon); accessory hairs 1a-S present or absent; valves small; saddle almost always complete (only in subgenus *Allotheobaldia* saddle incomplete); 3-X usually single; ventral brush of 5 or more pairs of branched hairs on grid and frequently 1-7 precratal hairs; anal papillae usually narrow, pointed.

EGGS. In most species eggs rounded at one end and tapered at the other (in some species both ends pointed); some species have eggs with short transparent stem; eggs laid usually in raft on water surface or singly on ground above water level.

DISTRIBUTION. The subgenus *Culiseta* is confined to the Holarctic, *Culicella* occurs in the Holarctic and Australian regions and *Neotheobaldia* is restricted to Australia. Of the three monotypic subgenera, *Theomyia* is restricted to the tropics of Africa, Austrotheobaldia is found in eastern Australia and Tasmania, while *Allotheobaldia* is distributed across the southern part of the Palaearctic from the Azores to Central Asia through the Ethiopian region into India and Pakistan.

The subgenus *Climacura* has a remarkable distribution; one species occurs in the eastern and central parts of the United States, one in West Malaysia, one in eastern Australia and two in New Zealand. As Marks (1968) has pointed out, the distribution pattern of *Culiseta* is a relict one, but there is no unanimity of opinion about the place of origin of the genus.

Maslov (1967) has postulated a northern origin which is centered in "Bering Land" where, during the end of the Mesozoic and early Tertiary, the climate was temperate. From this centre protoculisetines dispersed to the southwest and to the east and southeast across the tropics to Australia. However, Maslov's basic assumption that the subgenus *Culiseta* is the most primitive one does not seem to be justified. Surtees (1959) who made an extensive study of the structural and functional adaptations of the mouthparts of mosquito larvae concluded that filter feeding is primitive. This method is found in the members of the genus *Culiseta*, but not in the subgenus *Culiseta*. Here the larvae are browsers, and their mouth brushes are modified and adapted for scraping particles from submerged surfaces and on this basis the subgenus cannot be regarded as primitive. Marks (1968) has argued that the least specialised of the Australian representatives of the *Culicella* group are more primitive than the northern ones. On this basis and on Brundin's (1966) conclusion about an austral centre of origin of the family Chironomidae, Marks has postulated a southern centre of origin for *Culiseta*. However, Darlington (1970) has convincingly shown that the idea that primitive groups mark places of origin is erroneous. Further, it may be doubted whether a parallel can be drawn between chironomids and culicids. Brundin believes that the chironomids "originated in cool running waters;" their present distribution is markedly amphitropical (Brundin 1967). Culicid larvae which, in contrast to chironomids, are air-breathers, mostly favour still water and the greatest number of present day genera and species are tropical.

Belkin (1962) believes that intercontinental areas of the Old and New World, particularly those in the tropics, have been the places of origin and evolution of new types of mosquitoes. On the available evidence, it seems likely that *Culiseta* evolved in the tropics (Dobrotworsky 1965) and subsequently spread to the northern and southern temperate regions, being progressively displaced by later evolving elements.

There is no doubt that mosquitoes from tropical groups have dispersed to southern Australia and Tasmania and become adapted to cold climatic conditions. Anopheline mosquitoes, for example, entered Australia from the north, probably during the Pleistocene (Mackerras 1950), but *A. stigmaticus* Skuse now breeds in cold water (12^{o}-13^{o} C) in mountainous areas. Again, although species of *Aedes* of the subgenus *Finlaya* belong to the northern element of the Australian fauna (Mackerras 1950), *rubrithorax* (Macquart) is able

SPECIES OF *CULISETA* AND THE ARBOVIRUSES

Species	Virus	Incrimination A	B	C	Country	Reference
melanura	EEE	+		+	USA	Chamberlain et al. 1951, 1954; Holden et al. 1954; Hayes et al. 1962
melanura	Hart Park	+			USA	Whitney 1964
melanura	WEE	+			USA	Kissling et al. 1955; Hayes et al. 1961
inornata	WEE	+		+	USA & Canada	Hammon et al. 1945; Spalatin et al. 1963; Hammon & Reeves 1943a
inornata	SLE			+		Hammon & Reeves 1943b
inornata	Cache Valley	+			USA	Holden & Hess 1959
inornata	Jamestown Canyon	+			USA	Lamotte 1968
inornata	Jerry Slough	+			USA	Reeves 1968
incidens	WEE			+	USA	Hammon & Reeves 1943a
incidens	SLE			+	USA	Hammon & Reeves 1943b
tonnoiri	Whataroa	+			New Zealand	Ross et al. 1963
longiareolata	West Nile		+		Egypt	Hurlbut 1956
annulata	Tahyna	+			USSR	Danielova et al. 1970

A. By recovery from wild caught specimens.
B. By demonstrating multiplication of virus in mosquito.
C. By experimental transmission in laboratory.

to complete its development through to the adult stage at temperatures as low as 10°C. The present pattern of distribution of *Culiseta* is entirely consistent with a tropical origin.

BIOLOGY. Some species are restricted to treeless plains, others to forests or mountains, but a fair number do not show preference to a certain type of country. The majority of species breed in ground pools, bogs, ponds, marshes, edges of streams, rarely in treeholes. Some of the Australian species breed underground in the burrows of land crayfishes (*Engaeus* spp.). Only one species, *fraseri* is restricted to treeholes. A few breed under domestic conditions in artificial containers. In the northern areas, most species overwinter as hibernating adults, but some species do so as well in the larval stage; in the southern areas breeding may be almost continuous during the winter. Australian species overwinter mostly in the larval stage; New Zealand species both as adults and larvae. Biting activity in most species begins after sunset, but some are active during the day. Several species attack man as well as domestic animals. In nature they feed on wild mammals but some feed on birds and may prefer avian hosts.

MEDICAL IMPORTANCE. Several species of *Culiseta* have been found to be naturally infected with arthropod-borne viruses (arboviruses). The table shows that members of the genus are deeply involved in this field and suggests that they certainly deserve further examination in this respect. The species have mostly been incriminated through the isolation of viruses from wild caught specimens but wherever transmission has been attempted it appears to have been successful. It is of further interest to note that *melanura* was considered to be the primary vector during the great epidemic and epizootic of eastern equine encephalomyelitis which occurred in New Jersey, USA in 1959. Blanchard (1905) suggested that *longiareolata* might be involved in the transmission of the bacillus of Malta fever. Maslov (1967) reports the successful laboratory infection of *bergrothi* with the microfilariae of *Dirofilaria immitis* in the Amur region of the USSR.

KEYS TO THE WORLD SUBGENERA OF *CULISETA*

MALES AND FEMALES

1. No hairs at base of subcosta on underside of wing; male palpus barely half as long as proboscis and with only a few long bristles at its tip . . . . . *Theomyia*
   Hairs present at base of subcosta on underside of wing; male palpus as least two-thirds the length of proboscis 2

2(1). Postspiracular area with a few fine scales . . . . *Austrotheobaldia*
   Postspiracular area bare or with a few hairs 3

3(2). Tibia lined with white; male palpus shorter than proboscis; tergum IX with a pair of long processes . . . . . *Allotheobaldia*
   Tibia not lined with white; male palpus at least as long as proboscis 4

4(3). Base of subcosta on underside of wing with scanty hairs and not more than 5 spiracular bristles 5
   Spiracular bristles and hairs on underside of wing numerous 6

5(4). Anterior pronotum without scales or with very long hairlike scales; posterior pronotum with bristles and fine hairlike scales . . . . . *Climacura*
Australia only . . *Culicella*
Anterior and posterior pronotum with pale curved scales and bristles . . . . . *Neotheobaldia*
Australia only . . *Culicella*

6(4). Cross-veins approximated, usually *m-cu* in line with *r-m* but sometimes *m-cu* is well before *r-m*; last segment of male palpus more or less swollen, not turned upwards; basimere of male terminalia with subapical lobe or patch of hairs in its place. . . . . *Culiseta*
Cross-vein *m-cu* always well before *r-m;* last segment of male palpus may be more or less swollen; if not, often turned upwards; basimere of male terminalia without subapical lobe
. . . . . not Australia . . . *Culicella*

FOURTH STAGE LARVAE

1. Siphon with hair 1-S halfway along siphon . . . . . *Austrotheobaldia*
Siphon with hair 1-S at base 2

2(1). Siphon with pair of basal hairs only 3
Siphon with hairs 1a-S along ventral side of siphon in addition to basal pair . . . . . *Climacura*

3(2). Pecten of spine-like scales 4
Pecten of hair-like scales only . . . . . *Neotheobaldia*

4(3). Siphon long and slender; index 6-8 5
Siphon short; index 2.5 - 3.5 6

5(4). Antenna long; hair 1-A well beyond middle . . . . . *Culicella*
Antenna short; hair 1-A near middle; siphon heavily sclerotized, almost black; spines of pecten bifid from base . . . . . *Theomyia*

6(4). Siphon with pecten of spines only; saddle small not forming complete ring . . . . . *Allotheobaldia*
Siphon with row of hairs beyond pecten; saddle forming complete ring . . . . . *Culiseta*

SUBGENUS *CULISETA* FELT

Culiseta Felt 1904, Bull. N.Y. St. Mus. no. 79: 391c. Orthotype: *Culex absobrinus* Felt.

FEMALE. *Head.* Palpus with segment 5 sometimes distinctly white. *Thorax.* Anterior pronotum with bristles and a few scales; posterior pronotum with posterior bristles and with broad scales or some narrow ones; spiracular bristles usually more than 7 in number, a few scales may also be present at base of these; scutellum usually with narrow scales but *niveitaeniata* has broad scales. *Legs.* Tarsi all dark or with white basal bands. *Wing.*

Wings often spotted; base of Sc ventrally with large patch of hairs; cross-veins usually approximated. *Abdomen*. Tergum I with patch of scales and long bristles; remaining terga with more or less distinct basal pale bands.

MALE. In general similar to female. *Head*. Palpus about as long as proboscis or longer than it; usually with very long bristles; last segment more or less swollen but not turned upwards. *Terminalia*. Lobes of tergum IX usually with long setae; basimere with basal mesal lobe relatively small, conical, bearing numerous setae on sides and a few apical spines; subapical lobe usually more or less distinct or in place of it there is a patch of hairs; distimere with single, usually bifid terminal appendage; 2 plates of aedeagus usually separate, strongly sclerotized.

PUPA. Tip of midrib of paddle with single hair.

LARVA. *Head*. Head relatively not very large; antenna short or of moderate length; hair 1-A near middle, relatively short; hairs 2-6A usually short and on tip of antenna; some of mouth brushes serrated distally. *Abdomen*. Comb scales in triangular patch; siphon relatively short with index 2.5-3.5; pecten of strong teeth, with a row of hairs beyond; saddle forming complete ring; hair 2-X multibranched; ventral brush 4-X usually with a few tufts piercing saddle.

EGG. Eggs laid in rafts on water surface.

CULISETA (CULISETA) NIVEITAENIATA (THEOBALD)

(Figures 1, 2, 3, 4)

Pseudotheobaldia niveitaeniata Theobald 1907, Mon. Cul. 4: 272 (♂*).

Theobaldia niveitaeniata (Theobald), Barraud 1924, Indian J. med. Res. 12: 141; 1934, Faun. Brit. India, Diptera 5: 91 (♂*, ♀, L*); Edwards 1932, in Gen. Insect., Fasc. 194: 104; Stackelberg 1937, Faune de l'URSS, Ins., Dipt. 3(4); Qutubbudin 1952, Proc. R. ent. Soc. Lond. 21: 39 (L).

Theobaldia kanayamensis Yamada of Liu & Feng (*nec* Yamada) 1956, Acta ent. sinica 6(3): 335. Synonymized by Maslov (1964, 1967).

Culiseta (Culiseta) niveitaeniata (Theobald), Stone, Knight & Starcke 1959, Synop. Cat. Mosq. World 6: 219; Maslov 1964, Rev. d'Ent. de l'URSS 43(1): 206; 1967, Opred. Faune SSSR 93: 145 (♂*, ♀, L*).

Theobaldia (Theobaldia) sinensis Meng & Wu 1962, Acta ent. sinica 11(4): 383 (♂*, L*). Synonymized by Maslov (1964, 1967).

Culiseta (Culiseta) lishanensis Lien 1968, Trop. Med. 10(1): 6 (♂*, ♀*, P*, L*). New synonymy.

FEMALE. *Head*. (Figs. 1, 2) Vertex with pale decumbent scales; upright forked scales mostly dark; lateral scales flat, broad, pale; palpus dark brown, about 1/4 length of proboscis; some pale scales dorsally on segment 3; segment 5 small, but distinct, nude, pale; pedicel with broad white scales mesially. *Thorax*. (Figs. 1, 2) Anterior pronotum with broad pale scales; posterior pronotum with relatively narrow white scales dorsally and broad white scales on lower part; scutum clothed with narrow, curved golden scales; small patch of narrow white scales in front of wing root; scutellum with broad creamy-white scales; 6-8 spiracular bristles and sometimes 2-4 scales at base of bristles; pleural bristles pale, scales broad, white. *Legs*. (Fig. 2) Dark brown; coxa and trochanter with patch of broad pale scales; posterior surface of femur of fore and mid leg pale from base almost to tip; anteriorly fore femur with subapical white spot, hind femur white except for a subapical black ring and a dark line along dorsal side and a white kneespot and an apical tibial ring on all legs; tarsi dark, first tarsomere slightly paler ventrally at base in some specimens; tarsal claws as in Figure 1. *Wing*. (Fig. 1) Wing membrane with darker patches in regions of cross-veins and base of fork

cells; veins with narrow dark scales; cross-veins *r-m* and *m-cu* closely approximated. *Abdomen*. (Figs. 1, 2) Terga brownish-black; tergum I with patch of white scales medially; II-VII with whitish basal bands, which on terga IV and V narrows in middle; bands broken in middle on terga VI and VII.

MALE. In general similar to female. *Head*. (Fig. 2) Palpus dark brown, paler at joints, about as long as proboscis; segments 3 and 4 with long bristles, segment 5 widened and spatulate with a few strong, rather short bristles at tip; tarsal claws as in Figure 1. *Terminalia*. (Fig. 3) Tergum VIII without short stout spines on apical margin; each lobe of tergum IX with 8-13 setae; basimere narrow, about 3 times as long as broad at base and without scales; basal mesal lobe conical, relatively small, with 2 strong bristles, sometimes bent almost at right angles, and about 20 small fine setae; subapical lobe prominent with about 8 bristles, 4-7 of these stronger and with bent tip; distimere about half as long as basimere, terminal appendage relatively short, bifid; aedeagus simple with narrow pointed tip, sclerotized on ventral side; paraproct with 1 long and 3-4 short teeth apically and 3-4 cercal hairs.

PUPA. (Fig. 3). *Cephalothorax*. Respiratory trumpets about 2 1/2 times as long as pinna. Hair 8-C single; 9-C single or 2-branched. *Abdomen*. Hairs 1, 5-IV-VII single; 5-IV-VI very long, on VII shorter and weaker; 1-IV-V as long as 5, shorter and weaker on VI, VII; 6-I-VI single. *Paddle*. Oval, with posterior margin spiculated; hair 1-P single or with 2 branches.

LARVA. (Fig. 4) *Head*. Antenna short, about 1/2 length of head, with sparse, minute spiculation; hair 1-A inserted about at middle of shaft, with 4-6 slightly plumose branches, about 1/3-1/2 as long as shaft; hair 4-C small, fine, with 2-4 simple branches; 5-7-C plumose, 5-C 6-7b, 6-C with 3 unequal branches, median longest and strongest, 7-C 8-12b, 8-C single, 9-C 2-5b, 10-C with forked tip; median mouth brush hairs serrated distally; mentum with 12-13 lateral teeth on each side. *Thorax*. Prothoracic hairs more or less plumose; pleural groups of hairs well developed; hairs 1-3-P arising from a sclerotized plate, 1-P long, 3-5b, 2-P single, long, 3-P shorter than 2-P, 6-9b, 4-P 6-10b, 5, 6-P single, 7-P 5-9b, 8-P 4-5b, 9-P 4-7b, 10, 12-P single, long, 11-P very short, multibranched; 5-7-M single, long, 8-M 6-10b, plumose, on sclerotized plate; 7-T 13-15b, plumose, 9-T plumose, 8-12b, 13-T 4b. *Abdomen*. Hair 6-I, II 4-6b, 6-III-IV 2b; I-VIII 3b, 2, 4-VIII single; 3-VIII 7-12b, plumose, 5-VIII 4b; comb of about 40 scales; siphon index about 3.0, hair 1-S inserted at base 5-10b, plumose; pecten with 12-20 spines followed by an even row of 12-15 hairs extending to near apex of siphon; anal segment completely ringed by saddle; hair 1-X 2-4b, 2-X 7-8b; 3-X 1, 2b; ventral brush consisting of 15 tufts 1-3 of which precratal, 1 may be inserted in the saddle; anal papillae slender, tapering, more than twice as long as saddle

EGG. Unknown.

TYPE DATA. *Pseudotheobaldia niveitaeniata* Theobald 2 male cotypes in the British Museum. Type locality: Dehra Dun, *United Provinces*, INDIA. *Culiseta lishanensis* Lien, holotype male and allotype female with associated larval and pupal skins; paratypes 3 males and 6 females in Provincial Malaria Research Institute, Taipeh, Taiwan; 1 male and 1 female in USNM. Type locality: Lishan, *Taichung Hsien*, TAIWAN.

DISTRIBUTION. Specimens examined: INDIA, *Punjab*, Kasauli 3 males, 4 females; *Almora*, Kausani 1 female, 4 rearings. TAIWAN 6 males, 5 females, 6 rearings. Records from literature: INDIA, Punjab, Dehra Dun, Murree, Theog on Hindustan-Tibet road 2.439 m; *Uttar Pradesh*, Naini Tal, Muktesar. TIBET, Yatung, near Sikkim border 3.658 m. (Barraud 1934). CHINA, North East, Central and South (Maslov 1967).

TAXONOMIC DISCUSSION. In China, this species was misidentified by Liu & Feng (1956) as *Theobaldia kanayamensis* Yamada. Later it was described as a new species, *Theobaldia sinensis*, by Meng & Wu (1962) but Maslov (1964, 1967) has pointed out that there are no consistent differences between their species and *niveitaeniata*, which is more variable than Meng &

Wu realized. Lien (1968) described *lishanensis* from Taiwan as very closely related to *niveitaeniata* but distinct from it. I have examined the paratypes and also specimens collected at Alishan, Taiwan, and have found that there are no significant differences between them and *niveitaeniata* from India. It should be noted that Lien's description and drawings (his Figure 1E) of the terminalia of *lishanensis* are inaccurate; the terminalia does not differ from that of *niveitaeniata*. On these grounds I have relegated *lishanensis* to the synonymy.

BIOLOGY. The larvae are found in mountainous areas at an elevation of 1600 m. to 3658 m. They live in clear or polluted water in a wide variety of habitats such as ground and rock pools, pits, ditches, seepages, shallow wells and artificial containers. The larvae were usually present during the cooler part of the year from November to May and generally disappear during the rest of the year. According to Meng & Wu (1962) the larvae can survive in frozen pools. The adults I have seen, were collected in March and April. In China *niveitaeniata* bites cattle, water buffalo and man (Meng & Wu 1962).

SUBGENUS *CLIMACURA* HOWARD, DYAR & KNAB

Climacura Howard, Dyar & Knab 1915, Mosq. N. and C. Amer. 3: 452.
Orthotype: *Culex melanurus* Coquillett.

FEMALE. *Head*. Palpus with segment 5 small, round or elongate. *Thorax*. Anterior pronotum with bristles only; posterior pronotum with posterior bristles and very narrow scales; 1-7 spiracular bristles; scutellum with narrow scales. *Legs*. Tarsi all dark or with distinct basal bands on hind legs. *Wing*. Wing with or without spots; base of Sc with reduced number of ventral hairs; cross-vein *m-cu* well before *r-m*. *Abdomen*. Tergum I with setae only; terga II-VIII usually dark scaled; in *marchettei* terga V-VIII have basal pale bands.

MALE. In general similar to female. *Head*. Palpus as long as proboscis or longer, last segment slender. *Terminalia*. Lobes of tergum IX with long setae; basimere with relatively small conical basal mesal lobe bearing bristles, mostly medium to small but also a few strong ones; subapical lobe absent; distimere with single terminal appendage; aedeagus usually simple and weakly sclerotized except in *marchettei* where it has strongly sclerotized lateral walls and 3-4 prominent apical teeth.

PUPA. Tip of midrib of paddle with 2 hairs.

LARVA. *Head*. Head very large; antenna long and slender; hair 1-A, a large tuft well beyond middle of antenna; 2-A and 3-A very long and usually slightly removed from tip of antenna. *Abdomen*. Comb scales in a single row; siphon long, index 4.0-7.5; basal hair 1-S small, single or with 2-5 branches; ventral hairs 1a-S extending nearly to end of siphon; saddle forming complete ring; hair 2-X multibranched; precratal tufts of ventral brush 4-X, if present, small.

EGG. Eggs laid in rafts on water surface.

CULISETA (CLIMACURA) MARCHETTEI GARCIA, JEFFERY & RUDNICK

(Figures 5, 6, 7, 8)

Culiseta marchettei Garcia, Jeffery & Rudnick 1969, J. med. Ent. 6(3): 252 (♂*, ♀, L*, P*); 1968, Med. J. Malaya 23(1): 29.

FEMALE. *Head*. (Figs. 5, 6) Vertex with decumbent pale scales; upright forked scales blackish; lateral scales broad, pale; palpus about 1/5 length

of proboscis, brown; without scales. *Thorax*. Anterior pronotum without scales; posterior pronotum with fine black hair-like scales; 3-4 spiracular bristles; scutum and scutellum with narrow dark scales; pleuron with a few scales. *Legs*. (Fig. 6) Dark scaled; mid legs with pale scaling on posterior surface of femur and with lighter scales along tibia and at base of tarsomeres 1-3; hind femur with pale scaled posterior surface; tibia with pale scaled apex, tarsomeres 1-4 with basal pale bands, tarsomere 5 mostly white scaled; tarsal claws as in Figure 5. *Wing*. (Fig. 5) Membrane of wing clear; scales on veins uniformly dark; cross-veins without scales. *Abdomen*. Tergum I without scales, II-VII brown scaled, III and IV with lateral basal patches of white scales, V-VII with white basal bands, VIII mostly pale scaled; sterna mostly pale scaled.

MALE. In general similar to female. *Head*. (Figs. 5, 6) Palpus longer than proboscis, dark scaled with some pale scaling laterally on segments 2 and 3; distal part of segment 3 and segments 4 and 5 with long hairs; segment 5 slender. *Legs*. Tarsal claws as in Figure 5. *Terminalia*. (Fig. 7) Tergum VIII with some short, stout bristles at apical margin; each lobe of tergum IX with 2-4 setae; basimere long and conical, without scales; basal mesal lobe conical with 1-2 strong and some medium and small bristles; distimere simple, about half as long as basimere, terminal appendage broad, blunt, spoon-shaped; aedeagus more or less cylindrical, with lateral walls strongly sclerotized and with 3-4 prominent teeth; paraproct with 3-4 strong teeth apically and 3-4 cercal setae.

PUPA. (Fig. 7) *Cephalothorax*. Respiratory trumpets short with opening almost to base. Hair 8-C single; 9-C 2-3b. *Abdomen*. Hair 1-III strong, 5-6b; 1-IV strong, 3-4b; 5-IV, V strong, 4-5b; 6-I-IV single or 2b, 6-V 2b, 6-VI 4b, 6-VII 3-4b. *Paddle*. Oval; posterior margin with minute spicules; hair 1-P 2-3b; accessory hair single, short.

LARVA. (Fig. 8) *Head*. Head broader than long; antenna long, only slightly shorter than the length of head, with sparse minute spiculation; hair 1-A inserted on distal 1/7 of shaft with 20-25 plumose branches, more than 1/2 length of shaft; hair 4-C small, fine, 2b, 5-C about as long as 4-C about 10b, 6-C long, single, 7-C 5-9b, 8-C about 7b, 9-C minute about 8b, 10-C single, 11-C 4-6b, 13-C well developed 5-7b; all mouth brush hairs filiform; mentum with 7 teeth on each side. *Thorax*. Hairs 1-3-P arising from sclerotized base, 1, 2-P long, single, 3-P 3b, 4-P 5-9b, 5, 6-P single, 7-P 5-6b plumose, 8-P 4-6b plumose, 9, 10, 12-P single; 5, 6, 7-M single, 8-M about 6b plumose, 9-M about 10b plumose; 7-T 6-10b plumose, 9-T 7b plumose. *Abdomen*. Hairs 6-I, II 4-6b plumose, 6-III-VI 3-5b; 1-VIII 9-12b, 3-VIII 8-10b, 5-VIII 12-16b, 2, 4-VIII single; comb with a single row of 13-20 spindle shaped, finely fringed scales; siphon index 4.0-5.7, black on apical quarter; pecten with 9-11 spines; hair 1-S inserted at base, small, 3-5b, 1a-S in single row of 13-18 hairs (usually 6b) distal to pecten; abal segment completely ringed by saddle; hair 1-X small 5-7b, 2-X 3-4b, 3-X 2b; ventral brush consisting of 16-18 tufts, 1 or 2 precratal; gills narrow, more than twice as long as saddle, with constriction near base.

EGG. Elongate-oval, grey with posterior end narrower and darker; deposited in raspberry-shaped clusters of up to 149 eggs.

TYPE DATA. Holotype male, allotype female and paratypes: 4 males and 2 females with associated larval and pupal skins in U.S. National Museum. Type locality: Tanjong Rabok, Kuala Langat Forest Reserve, *Selangor*, WEST MALAYSIA.

DISTRIBUTION. Specimens examined: WEST MALAYSIA, *Selangor*, Tanjong Rabok, Kuala Langat Forest Reserve 1 paratype male and 1 paratype female, 3 larval and 3 pupal skins, 8 whole larvae. Records from literature: *Selangor*, Batang Berjuntai; *Pahang*, highway to Pekan, 32 km. from Kuantan (Garcia et al. 1968).

TAXONOMIC DISCUSSION. The species of the subgenus *Climacura* from North America, Australia and New Zealand show a great degree of similarity in the larval stages and in the terminalia of the male. In all these species the aedeagus has a simple structure and weak sclerotization. However, *marchettei* shows some specializations in the larva and the male genitalia. The siphon in *marchettei* is more heavily pigmented apically and the aedeagus is more sclerotized with prominent teeth apically.

BIOLOGY. Only adults have been collected, all of them in fresh-water peat-swamp forests. Although no larvae have been found in nature they have been successfully reared, from eggs, in the laboratory. Adults were obtained when larvae were reared in covered pans in an air-conditioned room at a temperature of 20-25°C. (Garcia et al. 1968, 1969). It is probable that like some Australian species of *Culiseta*, *marchettei* breeds in subterranean waters.

Adults have been recorded from traps baited with pig-tail monkey and chicken. However, freshly engorged mosquitoes were recovered only from the chicken-baited traps. Presumably this species prefers avian hosts.

ACKNOWLEDGEMENTS

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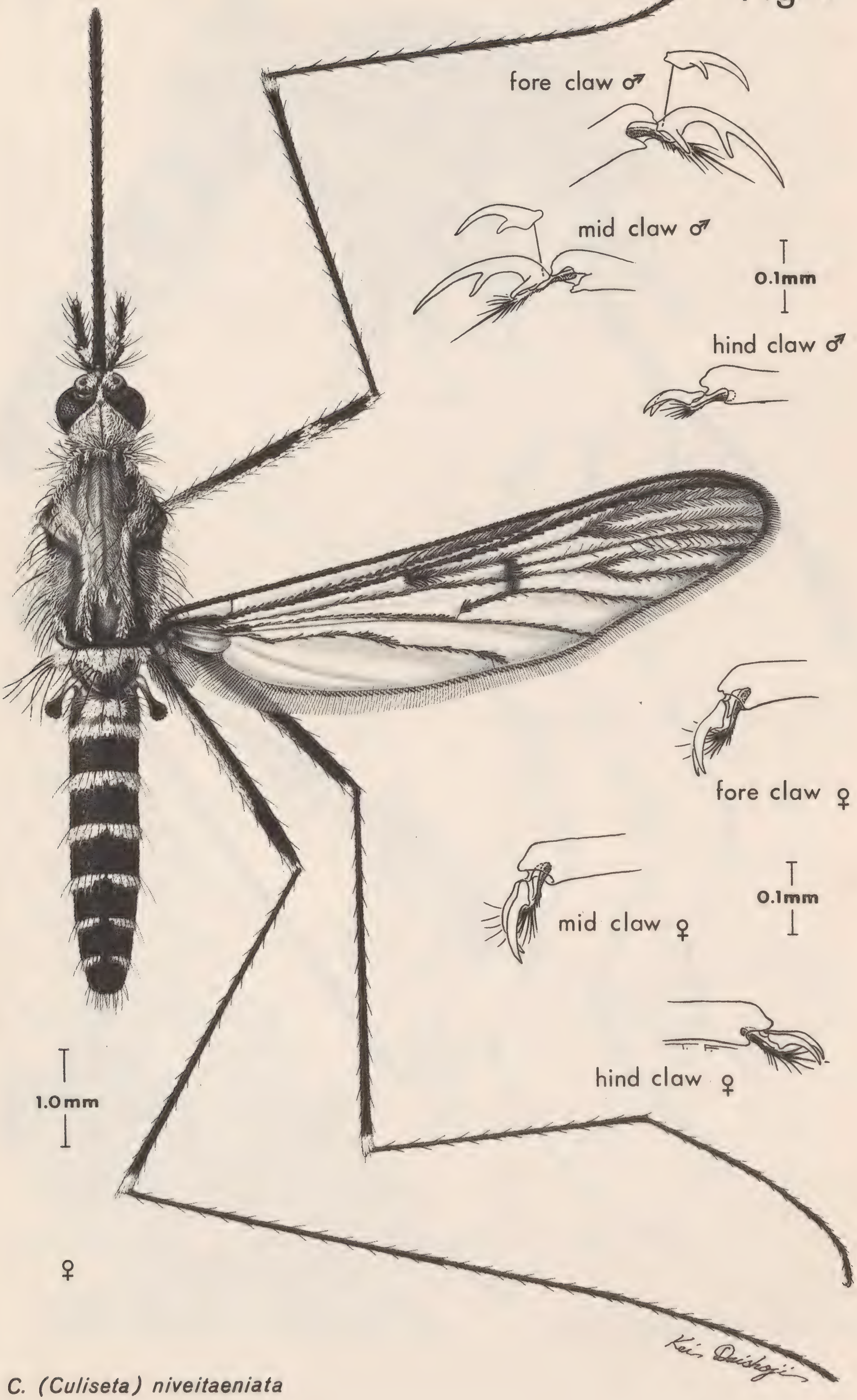
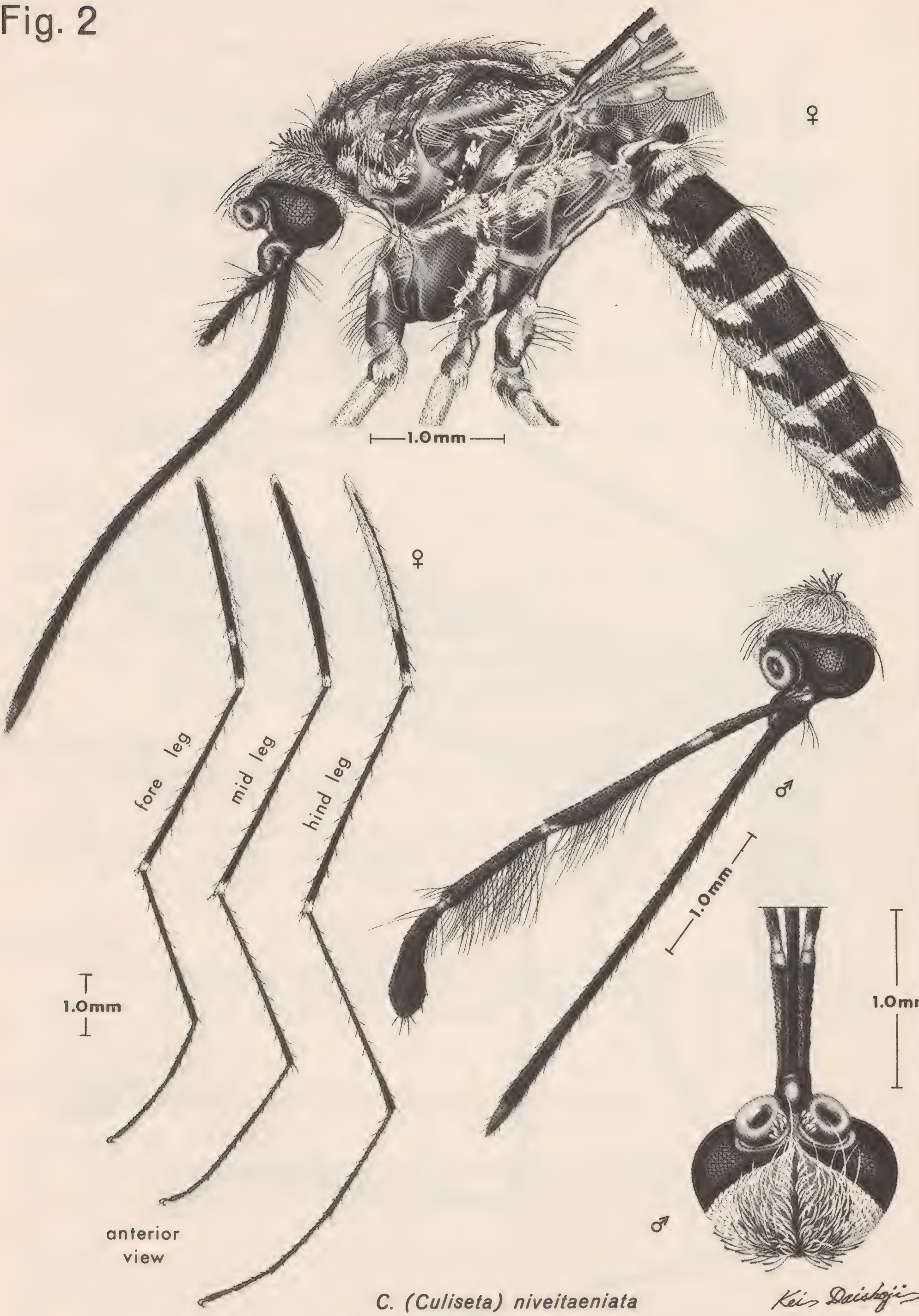
Fig. 1



C. (Culiseta) niveitaeniata

Fig. 2



C. (Culiseta) niveitaeniata

Kei Daishoji

Fig. 3

1.0 mm

C

aedeagus sternal view

aedeagus apex sternal view

0.1mm

IX-T

VIII-T

♂

I

II

III

IV

V

VI

VII

VIII

IX

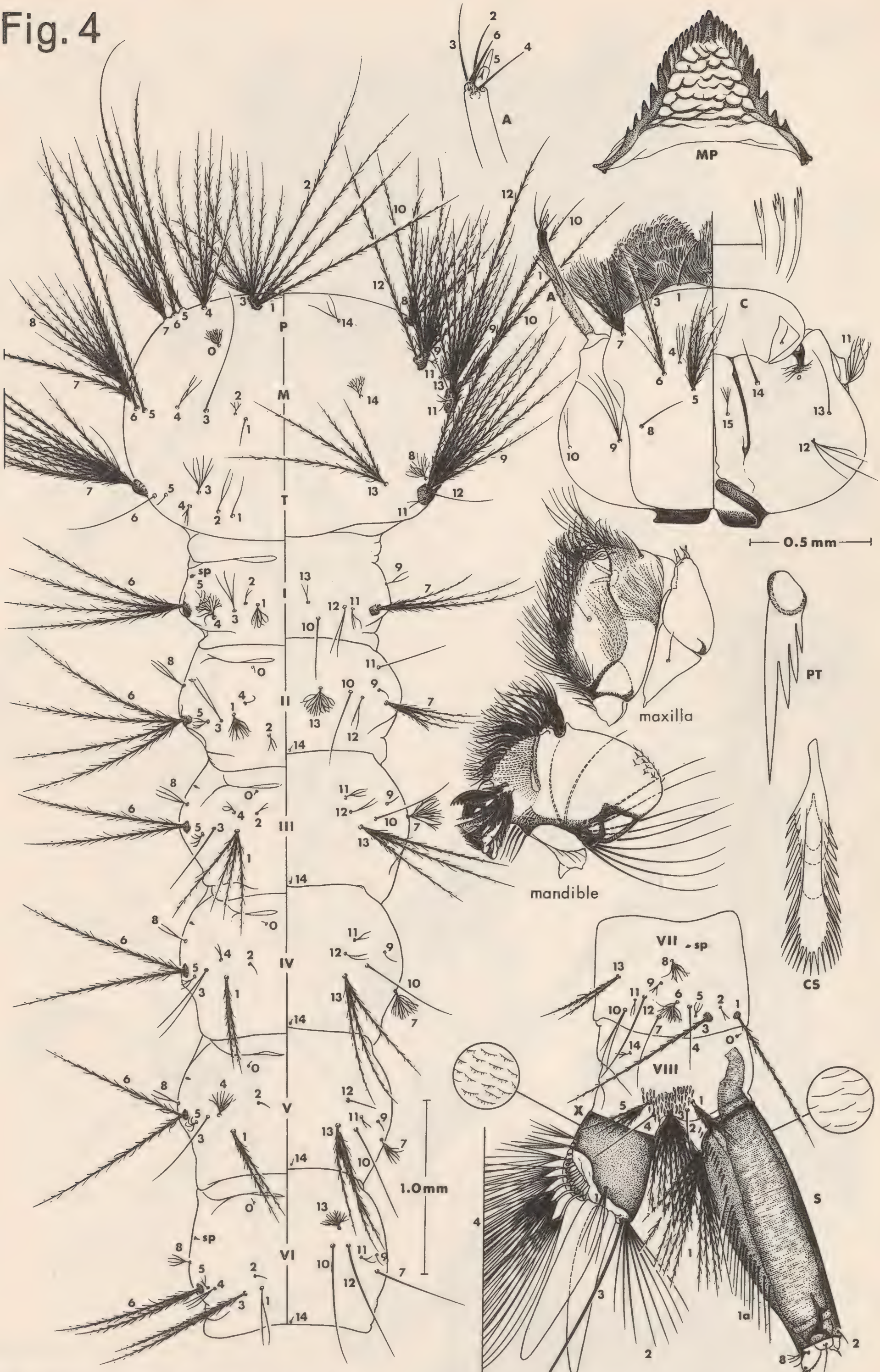
P

sp

1.0mm

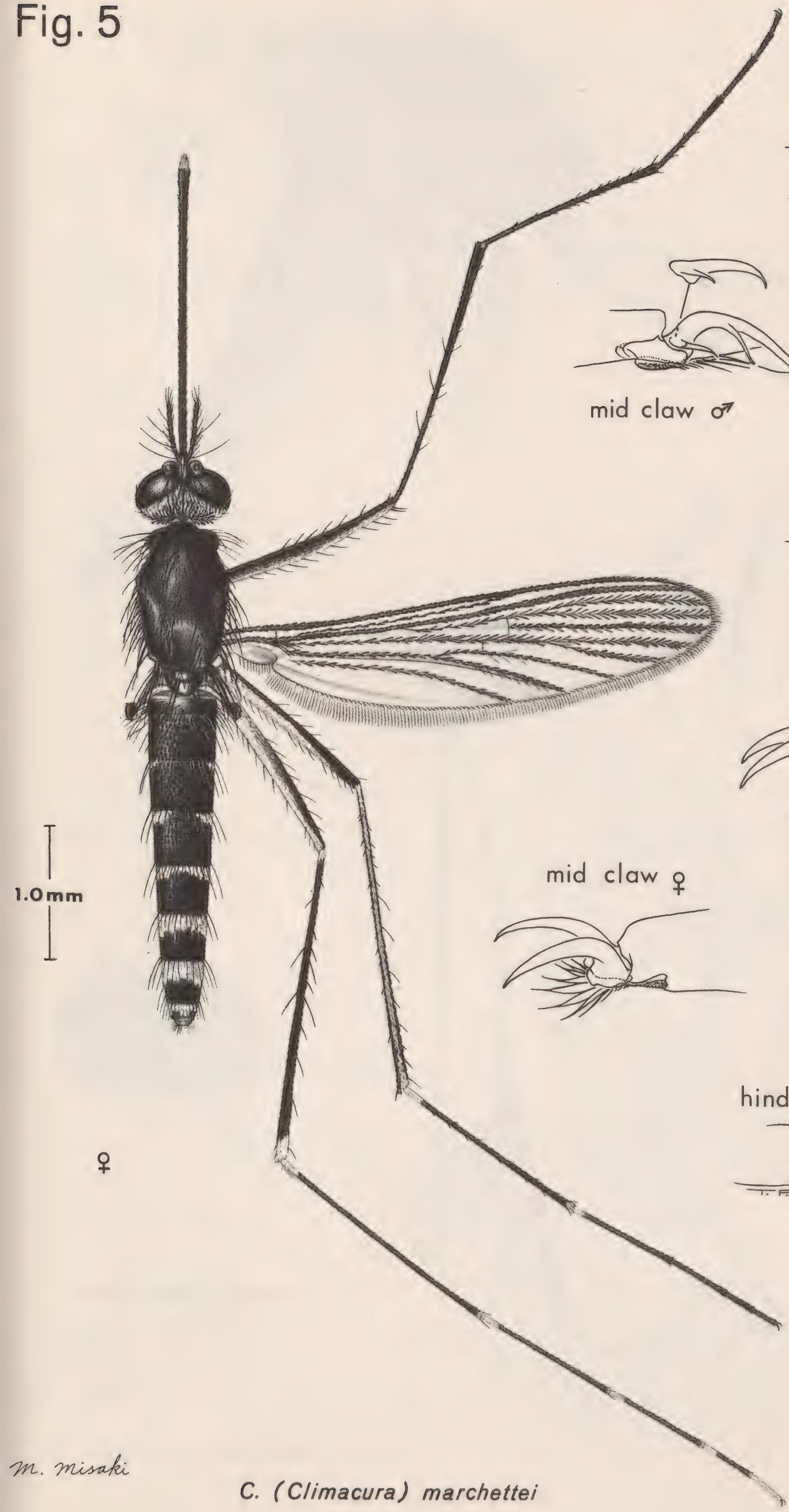
C. (Culiseta) niveitaeniata

Fig. 4



C. (Culiseta) niveitaeniata

Fig. 5



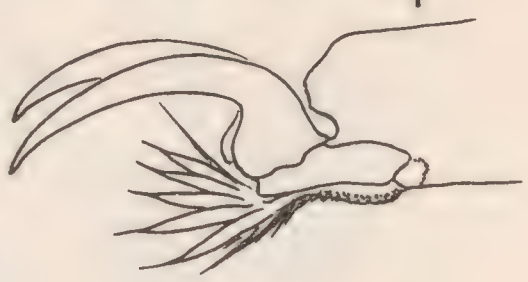
fore claw ♂

mid claw ♂

0.1mm

hind claw ♂

fore claw ♀



mid claw ♀

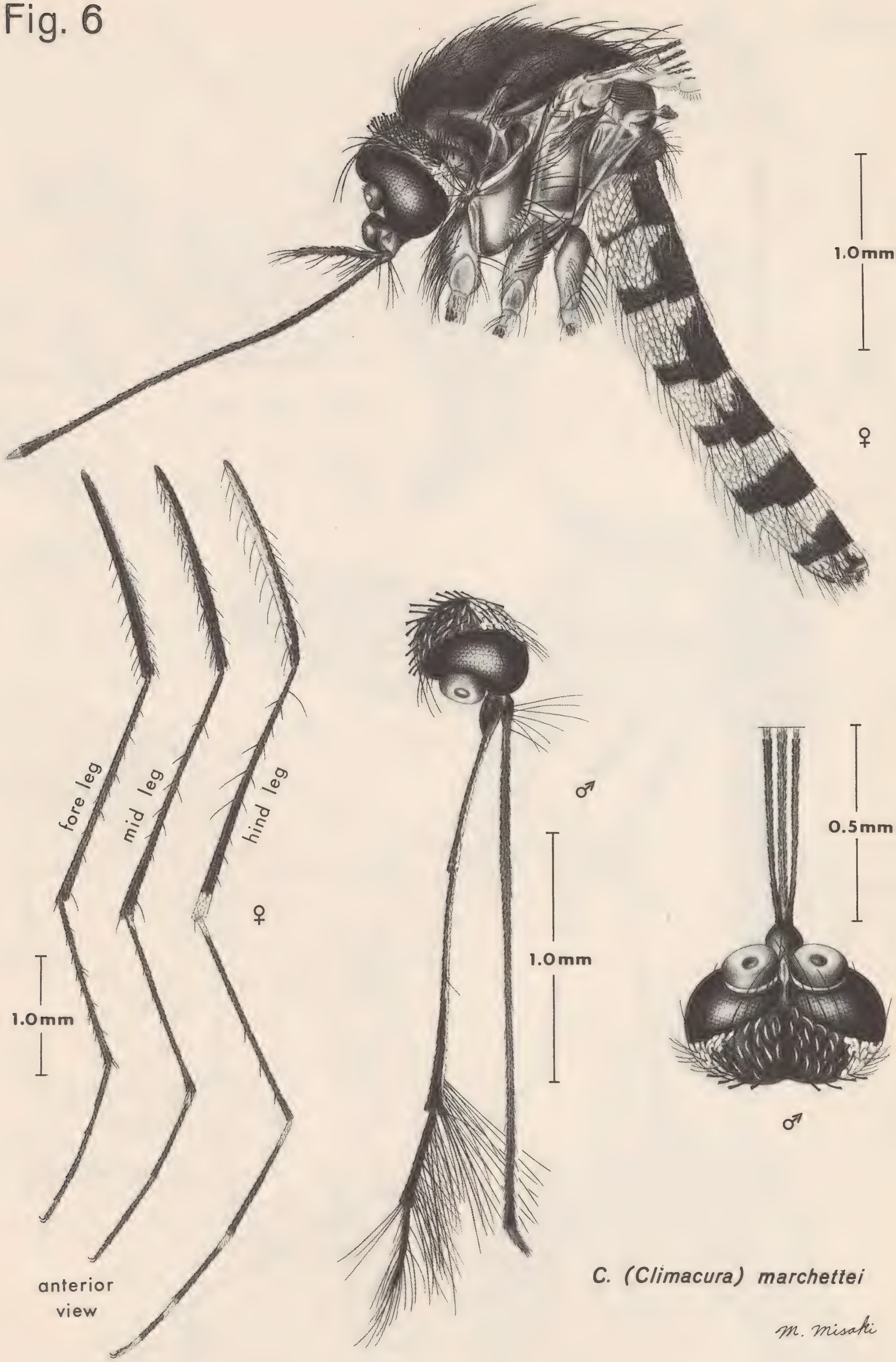
0.1mm

hind claw ♀

m. misaki

C. (Climacura) marchettei

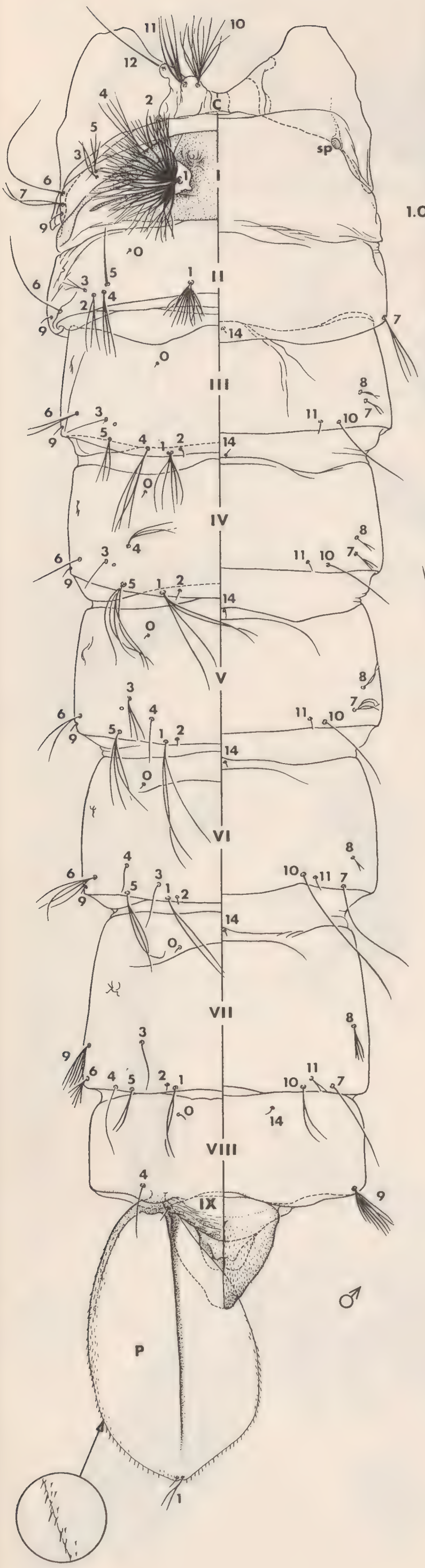
Fig. 6

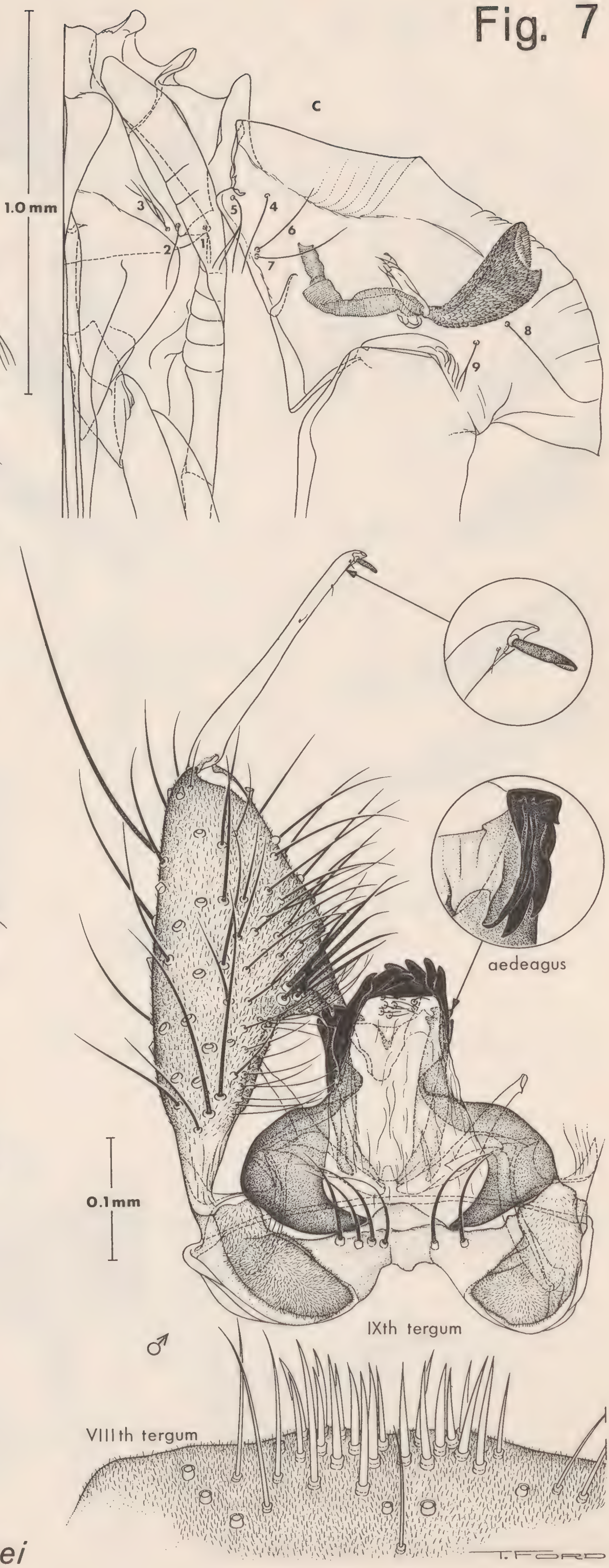


C. (Climacura) marchettei

M. Misaki

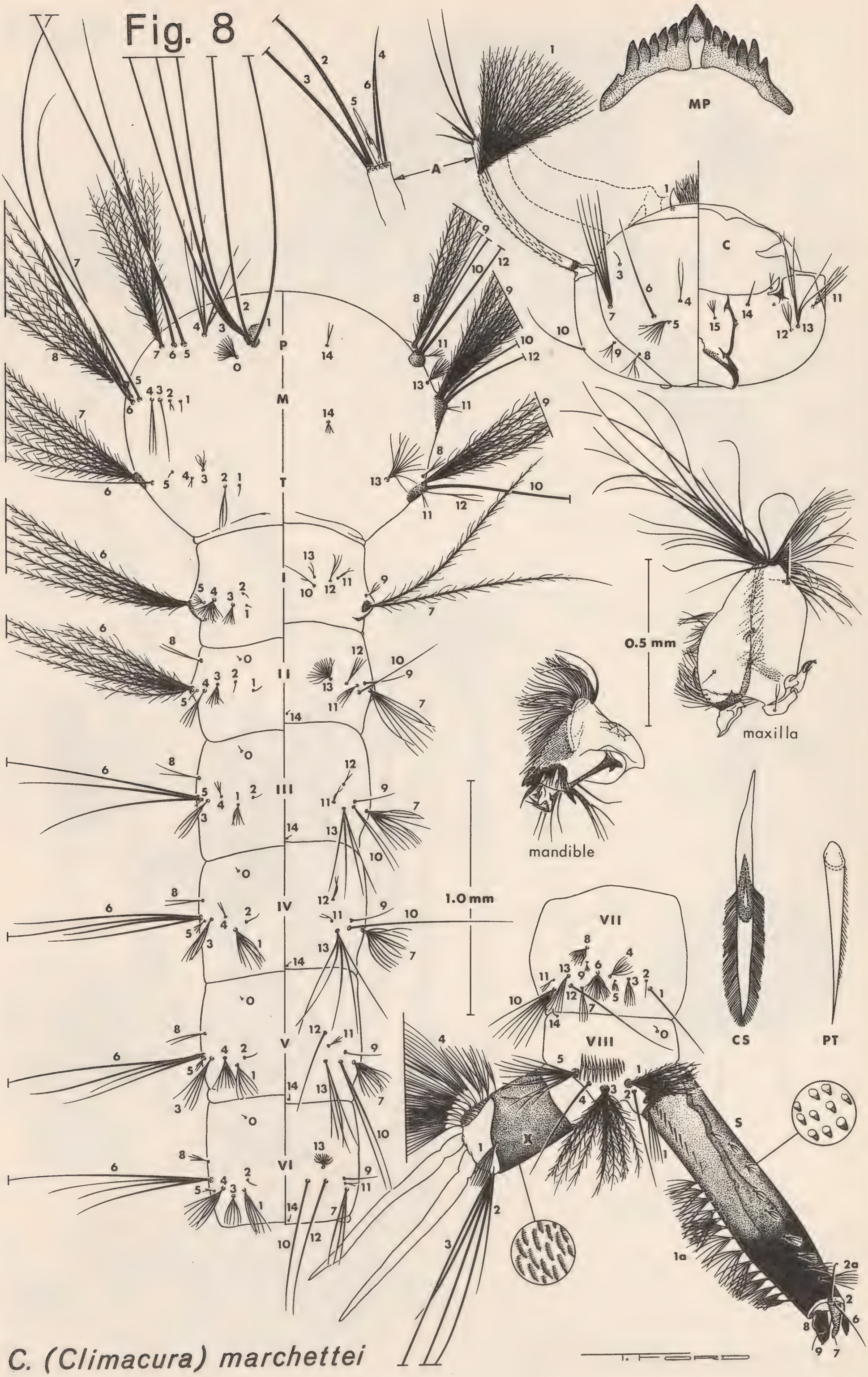
Fig. 7





C. (Climacura) marchettei

Fig. 8



C. (Climacura) marchettei

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Valid names are printed in roman type, synonyms are italicized. Italicized page numbers are those which begin the primary treatment of that species. Numbers in parenthesis refer to the figures illustrating some portion of that species.